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22 October 63

MEMORANDUM FOR THE RECORD

SUBJECT : OXCART Propulsion System Airflow Matching

1. The following progress has been made since July in defining subject problem area:

a. Engine turbine temperature drop-off with attendant rotor speed suppression although still not fully defined has been tentatively corrected by an increased acceleration schedule setting in the main fuel control.

b. Engine turbine temperature trim time delay has been corrected by incorporation of faster trim motors.

c. Engine power output as a result of the above two factors has been as specified per design since July. Flight test reports indicate good aircraft acceleration throughout the flight regime to Mach 3.0.

d. Nacelle inlet spike positioning except in certain instances wherein assignable causes have been identified has been according to preset schedules.

e. Until flight #82 on aircraft #121 on 24 September, inlet performance was substantially worse than design. Just prior to this flight the inlet had been modified for test purposes only to bleed more air from the aft end of the inlet into the secondary airflow passages through the nacelle to the ejector. Inlet performance was improved during the flight indicating a prior deficiency in the amount of bleed-off air.

f. As a result, Lockheed feeling is that the so-called aircraft "roughness" together with the low inlet performance may be due to internal duct flow separation in the area of and during bleed bypass doors open operation. These doors are located considerably forward of the engine face in the regime of high subsonic inlet flow. Cycling of flow separation, attempted re-attachment, separation again, and final re-attachment is felt

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NRO review(s) completed.
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to be inducing a vibration into the cantilevered spike centerbody which has a natural frequency of 70 cycles per second. Instrumentation on flights during September has revealed a 70 cycle per second vibration on the spike centerbody in both a vertical and lateral plane during bypass doors open operation. Correlation has been established between the lateral plane amplitudes recorded and the pilot's comments regarding the magnitude of the "roughness" felt. Bleeding more air from the aft end of the duct where lower subsonic velocities occur (with less susceptibility to separation) and by limiting bypass door opening to an "as required only on demand" signal for shock position has improved the "roughness" problem and has confirmed the existence of the suspected separation described above.

8. The above experience together with recent wind tunnel test data which indicates that the flow separation is probably due to a slightly excessive duct area in the vicinity of the bypass doors has lead Lockheed to further modify the inlet. This modification now in work on aircraft 2121 consists of reducing the duct area at the bypass doors by installation of streamlined humps called speed bubbles. These humps also provide a greater degree of airflow directional control to help reduce separation. This configuration is expected to be ready for flight 28 October. In addition, the existing flush type sliding bypass doors are then to be replaced with variable louvered type doors to provide a more positive directional control of bypass air as it leaves the duct.

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Aircraft Systems Division
(Special Activities)

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